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The effectiveness of math journal in improving the mathematics performance of grade 9 students

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ABSTRACT

This study employed a true experimental design to investigate the effectiveness of math journaling on the mathematics performance of Grade 9 students. The study spanned six weeks, with two groups of 25 students each selected to represent the control and experimental groups, respectively. The experimental group engaged in math journaling, while the control group followed a conventional instructional strategy. Both groups underwent pretest and posttest assessments based on Most Essential Learning Competencies. The findings revealed that after the intervention, the experimental group achieved a slightly higher mean post-test score. Statistical analysis indicated significant improvement within both groups after conventional instruction, and the experimental group demonstrating significant improvement with math journaling. Nevertheless, the post-test comparison between the groups did not yield a statistically significant difference suggesting that both instructional methods were equally effective in enhancing mathematics performance. The relevance of this study to mathematics instruction lies in its exploration of innovative strategies, such as math journaling, to potentially improve student learning outcomes in mathematics education.

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1. INTRODUCTION

In contemporary educational research, the persistent challenge of low performance in mathematics remains a focal point, drawing significant attention from scholars. Recent studies have undertaken a multifaceted approach, exploring diverse perspectives and interventions to tackle this issue. Notably, there is a burgeoning interest in understanding the role of socio-emotional factors and their influence on mathematical learning outcomes. Scholars are increasingly acknowledging that students' attitudes, beliefs, and emotional experiences regarding mathematics play a crucial role in shaping their engagement and performance in the subject (Brunzell et al., 2019). This recognition underscores the importance of considering not only cognitive factors but also socio-emotional dynamics in designing effective strategies to enhance mathematical learning. By delving deeper into these factors, researchers aim to develop more holistic approaches that address the complex interplay between psychological aspects and academic achievement in mathematics.

One emerging avenue of inquiry focuses on the role of written mathematical communication in facilitating learning. Research suggests that written mathematical communication not only aids students in their comprehension but also provides teachers with valuable insights into their understanding. It serves as a crucial bridge between prior knowledge and newly acquired information (Azizah et al., 2020). In the realm of mathematics education, students are expected to actively engage in class discussions and enhance their oral and written communication skills. Math journals, as highlighted by Camahalan and Young (2015), have emerged as a valuable tool for students to demonstrate their learning progress. These journals are viewed as

dynamic works in progress, where no page is deemed flawless. They serve as documentation of students' learning processes and reflective practices (McAnelly, 2021).

The utilization of math journals by teachers as a means of evaluating and understanding student thinking has garnered support from research findings. Students derive significant benefits from maintaining math journals, as they enhance learning and provide teachers with accurate assessments of students' understanding and areas where they may require additional support. Studies, such as that conducted by Kostos and Shin (2010), have demonstrated that the practice of keeping math journals enables students to articulate their mathematical ideas effectively and utilize mathematical language proficiently. Additionally, math journals facilitate communication between students and teachers, serving as a valuable tool for teacher evaluation and feedback.

The constructivist learning theory underscores the value of math journals as a pedagogical tool, as highlighted by Camahalan and Young (2015). Within this framework, students are guided to engage in journaling activities that prompt them to articulate and demonstrate their thoughts regularly. This approach is rooted in the belief that writing serves as a fundamental mechanism for the brain to forge connections between existing knowledge and new concepts, a notion supported by D'Angelo et al. (2012). Moreover, Kostos and Shin (2010) advocate for math journals as an effective means of formative assessment, enabling educators to gauge student progress and understanding over time.

Al-Rawahi and Al-Balushi (2015) assert that reflective journaling fosters self-regulated learning practices, such as self-reflection, thereby fostering a dialogical exchange that tailors instruction to individual needs and cultivates a supportive classroom environment. Consequently, journaling emerges as a versatile tool for differentiation, either through its direct implementation or by informing the selection of more targeted instructional strategies. For instance, Glogger et al. (2012) propose that learning journals serve as an innovative means of assessing students' mathematical learning strategies, particularly in middle school settings. By encouraging regular articulation of thoughts, journaling enhances procedural knowledge, conceptual understanding, and mathematical communication, contributing to overall academic growth in mathematics.

Despite the recognized potential of writing to learn in the field of mathematical education, there remains a notable gap in research, particularly concerning advanced mathematics. Starkey (2016) highlights this deficiency, indicating a need for more investigation into the efficacy of writing as a tool for learning complex mathematical concepts. Adu-Gyamfi et al. (2010) shed light on the importance of fostering a classroom environment where students engage in both reading and writing to convey their understanding of mathematics. Their findings suggest that such a culture may be essential for making reading and writing meaningful components of a student's mathematical experience. This insight underscores the necessity of integrating writing activities into mathematics instruction to enhance comprehension and retention. Bossé and Faulconer (2008) distinguish between reading and writing about math and reading and writing in math, emphasizing that the latter involves active engagement with mathematical concepts through written expression. They argue that students who are supported, provided with opportunities, and encouraged to engage in purposeful writing and reading within mathematics classrooms develop a more robust understanding of mathematical concepts. Furthermore, these students are better equipped to apply their knowledge to various contexts, indicating the significant benefits of incorporating writing activities into mathematics education.

The study on the effectiveness of math journaling holds considerable significance for researchers, as it explores the potential impact of incorporating writing activities into mathematics learning. While the influence of reading and writing on student learning and academic performance is well-established in language subjects, its application in the context of mathematics learning warrants further investigation. Understanding how students engage with mathematical concepts through writing can shed light on the underlying factors that affect their learning process, such as note-taking and the ability to independently comprehend and apply mathematical processes based on these notes. Additionally, research on the effectiveness of teaching strategies in mathematics holds particular relevance in academic environments, especially in regions where mathematics is commonly perceived as a challenging subject, as noted in the case of many Filipino students. By examining the efficacy of different teaching approaches, educators can identify methods that effectively support student learning and address the specific challenges associated with mathematics education. This research not only contributes to the advancement of pedagogical practices but also has the potential to improve student outcomes and foster greater confidence and competence in mathematics among students.

Through the insights garnered from this study, researchers anticipate the development of instructional programs integrating math journaling as a pivotal strategy. Specifically, drawing from the study's results, they intend to create a comprehensive manual of procedures for implementing mathematics journaling in high school mathematics curricula. Additionally, training sessions aimed at fostering effective

utilization of this strategy may be organized. This initiative contributes to the broader literature advocating for the integration of reading and writing activities not only within language courses but also as essential tools for enhancing mathematics education. By embracing such approaches, educators and students alike can elevate mathematics teaching and learning experiences, thereby potentially improving student performance in the subject. Generally, this paper would like to test the effectiveness of math journalling in improving the students' performance in Grade 9 mathematics.

2. METHODOLOGY

2.1. Design

This study employed a quasi-experimental design, conducted during the fourth quarter of the 2022-2023 school year, involving Grade 9 students from two sections at a public high school in San Jose, Occidental Mindoro. The research duration spanned six weeks, with the selection of the first two sections, characterized by similar abilities, as the study's two respondent groups.

2.2. Sample

This study involved Grade 9 students from two sections in a public high school in San Jose, Occidental Mindoro. All students from both sections were included in the study, although only 25 students per section were chosen as actual participants whose test results contributed to the statistical analyses. This approach ensured inclusivity while maintaining homogeneity between the two groups. Additionally, the respondents were chosen randomly in each section, considering that they belonged to the same mathematical ability as measured by a pre-test given to them before the experiment. In this design, the experimental group engaged in learning through math journaling, while the control group followed a conventional instructional strategy.

2.3. Research Instrument

These pre-tests were crafted based on the Most Essential Learning Competencies (MELCs) pertinent to the grade level under study, ensuring alignment with curriculum standards. The instruments used for pre-test assessments were validated for content validity by a master teacher with specialized expertise in teaching at the grade level of interest.

2.4. Data Gathering Procedure

Firstly, both the experimental and control groups underwent a pre-test aimed at establishing baseline comparability between them.

Following the pre-test phase, the experimental group underwent a structured intervention comprising five distinct phases. The first phase involved the introduction of math journals, serving as a tool for documenting and reflecting on mathematical concepts and problem-solving strategies. Subsequently, the experimental group was introduced to the specific mathematical topic under investigation. Integrated teaching and learning using the math journals constituted the third phase, where students engaged in activities designed to promote deep understanding and application of mathematical concepts through journal entries and exercises. The fourth phase involved continued teaching and learning, with a focus on utilizing the math journals as a central component of instruction. Throughout this phase, students were encouraged to actively engage with the journal prompts and reflect on their problem-solving processes. Finally, the fifth phase consisted of a post-test assessment administered to the experimental group to evaluate the impact of the intervention. The post-test questions were carefully crafted to assess the extent to which students had mastered the targeted learning competencies following the intervention.

In contrast, the control group followed a more conventional approach to instruction. After completing the pre-test phase, they were introduced to the same mathematical topic as the experimental group. However, instead of utilizing math journals as a central component of instruction, the control group engaged in teaching and learning activities supplemented with additional exercises. This approach aimed to provide a comparative baseline for assessing the effectiveness of the intervention implemented with the experimental group.

2.5. Ethical Considerations

Throughout the study, ethical standards were strictly upheld. Informed consent was obtained from both students and their guardians prior to participation, ensuring that they understood the purpose and procedures of the research. Participants were assured of their anonymity and the confidentiality of their data. The right to withdraw from the study at any time without penalty was clearly communicated, fostering a voluntary participation environment. Additionally, measures were taken to minimize any potential discomfort or anxiety related to assessments, ensuring that all participants felt safe and supported throughout the research process.

2.6. Data Analysis

To analyze the data and evaluate the outcomes achieved by both groups, an independent t-test was applied. This statistical technique allowed for the comparison of mean scores between the experimental and control groups, providing insight into the effectiveness of the intervention in enhancing learning outcomes. Additionally, ethical measures were carefully considered throughout the study to ensure the well-being and rights of the participants. These measures included obtaining informed consent from all participants, ensuring confidentiality and anonymity of data, and adhering to ethical guidelines for research involving human subjects.

3. RESULTS

3.1. Mathematics performance of two groups before and after conventional instruction and integration of math journaling

Prior to the intervention, the control group (8.40 ± 1.92) shows a need for improvement in mathematical abilities. In contrast, the experimental group had a slightly higher score (9.80 ± 3.05), also suggesting room for enhancement. After the intervention, both groups showed significant improvements. The control group's mean score (15.40 ± 91.92) increased, though the high standard deviation suggests the presence of outliers affecting the interpretation. Despite this, the overall improvement indicates better performance. Meanwhile, the experimental group exhibited a more consistent improvement, with their mean score increased (16.40 ± 3.44), reflecting good performance. These results suggest that integrating math journaling with conventional instruction can enhance mathematical performance, particularly in the experimental group, which demonstrated more promising gains [Table 1].

Table 1. Mathematics performance of two groups before and after conventional instruction and integration of math journaling.

MATHEMATICS PERFORMANCE	CONTROL		EXPERIMENTAL	
	Mean Score	SD	Mean Score	SD
Pre-Test	8.40	1.92	9.80	3.05
Posttest	15.40	91.92	16.40	3.44

Scale: 26-30: Excellent; 21-25: Very good; 16-20: Good; 11-15: Fair; 1-10: Needs improvement

3.2. Difference in mathematics performance between control and experimental groups before and after conventional instruction and math journaling integration

The control group showed a significant increase in post-intervention scores (15.40 ± 1.92) compared to pre-intervention scores (8.40 ± 1.92).The t-test result ($t = 9.985$, $p < .001$) indicates a significant difference in performance before and after the intervention within the control group. Similarly, the experimental showed a significant increase in post-intervention (16.40 ± 3.44) as compared to the pre-intervention score (9.80 ± 3.05). The t-test result ($t = 5.559$, $p < .001$) also indicates a significant difference in performance before and after the intervention within the experimental group. These results suggest that both groups experienced substantial improvements in mathematics performance following the intervention, as evidenced by the significant t-test results and low p-values. [Table 2].

Table 2. T-test analysis of mathematics performance between control and experimental groups before and after conventional instruction and math journaling integration.

MATHEMATICS PERFORMANCE	BEFORE		AFTER		t	p-value
	Mean Score	SD	Mean Score	SD		
Control Group	8.40	1.92	15.40	1.92	9.985	<.001
Experimental Group	9.80	3.05	16.40	3.44	5.559	<.001

3.3. Difference in mathematics performance between control and experimental groups after conventional instruction and math journaling integration

The experimental group exhibited higher mathematics performance score (16.40 ± 3.44) as compared to control group (15.40 ± 1.92). However, the difference between two scores has no significance ($t = .983$, $p = .106$). Therefore, it can be concluded that the intervention did not lead to a noticeable discrepancy in mathematics performance between the two groups at the posttest stage [Table 3].

Table 3. T-test analysis of mathematics performance difference between control and experimental groups after conventional instruction and math journaling integration.

MATHEMATICS PERFORMANCE	CONTROL		EXPERIMENTAL		t	p-value
	Mean Score	SD	Mean Score	SD		
Posttest	15.40	1.92	16.40	3.44	.983	.106

4. DISCUSSION

The study's findings demonstrate a notable enhancement in students' mathematics performance subsequent to the intervention, with both control and experimental groups exhibiting advancement. This observation is consistent with existing research that underscores the effectiveness of targeted interventions in addressing fundamental mathematical skills. The initial identification of low proficiency levels underscores the necessity for diagnostic assessments to customize instruction, a method endorsed by research as pivotal for successful teaching (Baker et al., 2010). These outcomes also resonate with recent literature advocating for the integration of journaling activities into mathematics education. Incorporating math journaling prompts students to participate in reflective thinking, articulate problem-solving methodologies, and establish connections between mathematical concepts (Hernandez-Martinez et al., 2019; Radaković et al., 2020). Furthermore, journaling nurtures metacognitive skills such as goal setting, monitoring, and self-assessment of learning progress, all of which are essential for mathematical proficiency (Schoenfeld, 2017). The implications of these findings are profound for educators and curriculum developers within the realm of mathematics education. Integrating math journaling into instructional strategies can augment students' mathematical performance and facilitate a deeper conceptual grasp. Educators are encouraged to contemplate the inclusion of journaling activities in their teaching methodologies to bolster students' mathematical learning and overall development.

The results presented in the study underscore the efficacy of the intervention, which combined conventional instruction with the integration of math journaling, in enhancing mathematics performance across both the control and experimental groups. The t-test analysis conducted to assess the difference in performance before and after the intervention revealed significant improvements within each group. This indicates that both groups experienced substantial enhancements in mathematics performance subsequent to the intervention. These findings are consistent with prior research that has demonstrated the effectiveness of incorporating math journaling alongside conventional instruction to facilitate mathematical learning and comprehension (Van Es & Sherin, 2008; Kim et al., 2018). By encouraging students to engage in reflective thinking and articulate their problem-solving strategies, math journaling promotes deeper conceptual understanding and leads to improved performance in mathematics. These underscore the significance of integrating innovative pedagogical approaches, such as math journaling, into mathematics education to bolster students' learning and development. This highlights the importance of adopting strategies that not only enhance academic performance but also foster critical thinking skills and deeper understanding of mathematical concepts.

The observed lack of statistically significant difference in performance between the control and experimental groups post-intervention suggests that the integration of math journaling alongside conventional instruction might not have resulted in a discernible gap in mathematics performance between the two groups at the posttest stage. However, it's crucial to interpret these findings cautiously and take into account potential factors that could have influenced the outcomes. Further research is warranted to delve deeper into the effectiveness of various instructional interventions or different implementations of math journaling to gain a more comprehensive understanding of their impact on mathematics performance among students. This could involve exploring variations in the frequency or structure of journaling activities, as well as examining how other factors such as student engagement, teacher training, or classroom environment might influence the outcomes.

The unexpected results regarding the effectiveness of math journaling in improving mathematics performance, despite its documented benefits in previous literature, prompt a critical examination of the study's design and implementation. While math journaling has been shown to bolster reflective thinking, problem-solving strategies, and metacognitive skills—essential components for enhancing mathematics performance—it's crucial to contextualize these findings within the specifics of the study. Factors such as variations in instructional practices, levels of student engagement, or the duration and intensity of the intervention could have played a significant role in influencing the outcomes (Hernandez-Martinez et al., 2019; Radaković et al., 2020). For instance, the way math journaling was integrated into the curriculum, the frequency of journaling activities, or the level of scaffolding provided to students during journaling tasks might have varied across classrooms or instructional settings. Furthermore, other contextual factors such as the demographics of the student population, teacher training and experience, or the overall classroom environment could have also impacted the effectiveness of the intervention. It's essential to consider these

variables when interpreting the results and drawing conclusions about the efficacy of math journaling in this particular study. While the findings may seem surprising given the established benefits of math journaling, they underscore the importance of carefully designing and implementing educational interventions and considering the complex interplay of factors that can influence student outcomes. Further research exploring these factors in more detail could provide valuable insights into how to optimize the use of math journaling and other instructional strategies to support students' mathematical learning and development effectively.

The results underscore the complexity of educational interventions and the importance of carefully designing and implementing them to maximize their effectiveness. Further research is warranted to explore the nuances of integrating math journaling into mathematics instruction and to identify the conditions under which it may lead to significant improvements in student performance. While the integration of math journaling alongside conventional instruction did not result in a significant difference in mathematics performance between the control and experimental groups in this study, it remains a promising pedagogical approach that warrants further investigation and refinement.

5. CONCLUSION

The study's findings shed light on the efficacy of incorporating math journaling alongside conventional instruction to bolster students' mathematics performance. While the control group saw substantial progress through conventional methods, the experimental group experienced significant enhancement in mathematics proficiency due to the integration of math journaling. These results are in line with the study's objectives, which aimed to evaluate the impact of instructional interventions, including math journaling, on students' mathematical skills.

Remarkably, the comparison of post-test scores between the control and experimental groups did not reveal a statistically significant difference, indicating comparable mathematics performance levels post-intervention. Despite this, both conventional instruction and math journaling proved equally effective in fostering improved mathematics skills among students. This underscores the potential of math journaling as a pedagogical tool to complement traditional teaching methods in mathematics education. These findings also advocate for the integration of math journaling alongside conventional instruction as an effective strategy for enriching mathematics learning outcomes.

In essence, the study suggests that both math journaling and conventional instruction effectively enhance Grade 9 students' mathematics performance. Although the experimental group exhibited slightly higher mean scores, the lack of statistical significance emphasizes the equitable effectiveness of both approaches. These findings underscore the importance of embracing innovative methodologies like math journaling in mathematics education and offer valuable guidance for educators seeking impactful instructional strategies for their students.

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